Syllabus PSS 5377
Cotton Fiber: Genotype to Phenotype Characterization

INSTRUCTORS CONTACT INFORMATION

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PREREQUISITES
Introductory courses in plant biology and genetics

COURSE DESCRIPTION

This course focuses on an integrated approach that relates the genetics of cotton fiber morphogenesis to fiber macro- and micro-structures to fiber physical and mechanical properties, to genetic improvement strategies. Cotton fiber morphogenesis encompasses the genomic, metabolic, biochemical and genetic aspects of cell wall development. Cotton fiber cell wall biogenesis is a complex phenomenon. Perturbation of this complex process greatly impacts the commercial value of the industrial raw material. Based on practical examples, this course will explain the complex relationships between cell wall development and fiber structure. The tools used to diagnose the effect of genotypic differences on the phenotypes will be briefly explained while the meaning of the data obtained from these tools will be detailed.
COURSE OBJECTIVES AND / OR LEARNING OUTCOMES

This course provides a fundamental understanding of the complex relationships that exist between cotton fiber morphogenesis (i.e., the biogenesis of the primary and the secondary cell wall), the genetics of fiber development and fiber quality, fiber macro- and microstructures (such as number of twists, reversals, fiber perimeter, orientation of the fibrils, degree of crystallinity), and fiber physical and mechanical properties (such as fiber maturity and strength).

Upon completion of this course, the students will be able to:

- Understand the impact of fiber morphogenesis on the fiber structure and physical properties.
- Demonstrate their competence in understanding and interpreting cotton fiber testing data (HVI, AFIS, cross-sections, etc).
- Understand the basis for cotton fiber structural characterization using analytical instruments (such as FTIR microspectroscopy, Chromatography, X-Ray diffraction, etc.)
- Apply knowledge to genetic improvement strategies to improve fiber quality through changes in cell wall composition and architecture.

COURSE REQUIREMENTS

Course requirements include a midterm and final exam, critical review of research paper, topical assignments, and class participation.

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Daily work and class participation</td>
<td>10%</td>
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<tr>
<td>Paper review</td>
<td>20%</td>
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<tr>
<td>Mid-term exam</td>
<td>35%</td>
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<td>Final exam</td>
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EVALUATION

GRADING SCALE:

- A  90 - 100
- B  80 - 89
- C  70 - 79
- D  60 - 69
- F  Less than 60

GRADING POLICY:

Grading will be based on the quality of the student’s work, initiative in pursuing knowledge, and thoroughness of assignments. Failure to attend class will significantly reduce your grade potential.

A  Outstanding, thorough, creative, and greatly exceeds expectations.

A grade of “A” will be awarded for work which far exceeds the minimum expectations of the assignment, not only by doing all that is asked, but by demonstrating superior skill,
thoroughness, independence, pursuit in new understandings, creativity, and academic propriety

B  A disciplined approach with some mastery of the material while showing creativity and exceeding expectations.

Grades in the “B” / “B+” range are very good grades. “B” grades indicate above average grasp and mastery of the subject matter, evidenced not only by meeting the basic objectives, but also by showing some initiative in pursuing lines of inquiry and creativity in pursuing new understandings.

C  Satisfactory work that met expectations.

Grades in the “C” /“C+” range indicate that the basic objectives of the course have been achieved, and that the student has demonstrated satisfactory mastery of the material. The student met the minimum expectations of the Instructor.

D  Below expectations for college-level work.

A grade of “D” is assigned to work that is passing, but below average competency for college students. The student receiving a grade of “D” has not exerted a level of effort or expertise expected of the average college student. This level of work is often largely incorrect or minimally thought-out and researched.

F  Lack of command over course material.

An “F” is assigned to a failing effort. This sort of work does not meet the minimum expectations of the assignment, demonstrates an unjustifiable lack of command over course material, and a significant absence of effort on the part of the student.

TEXTBOOK AND OTHER MATERIALS NEEDED

No textbook has been assigned to this course. A calculator will be needed for exam periods.

WebCT

Lectures, background information, and study aids will be accessible through WebCT (www.webct.ttu.edu). Use your e-raider logon and password to use WebCT. You can also contact each instructor using the WebCT e-mail system regarding class questions.

CLASS EXPECTATIONS

1. Students missing an exam with an excused absence may make up the exam within one week of scheduled exam. No Incompletes will be issued for final grades. If student work is missing, averages will be calculated with a zero for missing work.
2. Students must abide by policies in the University Catalog, Student Handbook, and if applicable, program handbook. Academic misconduct will not be tolerated.
3. A student who stops attending class will receive a grade of "F". To receive a "W" grade, the student must officially withdraw from the course by semester Drop/Add date.
ACADEMIC REGULATIONS

Please refer to the 2005-06 Texas Tech University Undergraduate and Graduate Catalog (p. 48-51) for a complete list of “Academic Regulations”.

Reporting Illness: In case of illness that will require absence from class for more than one week, the student should notify his or her academic dean. The dean’s office will inform the student’s instructors through the departmental office. In case of class absences because of a brief illness, the student should inform the instructor directly. Other information related to illness is found in the Student Handbook and the Residence Halls Handbook.

Absence Due to Religious Observance: a student who is absent from class for the observance of a religious holy day, according to the legal definition, will be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the 15th day after the first day of the semester, the student has notified the instructor of each scheduled class that the student will be absent for a religious holy day.

This notification will be in writing and will be delivered by the student personally, with the receipt of the notification acknowledged and dated by the instructor, or by certified mail, return receipt requested, addressed to the instructor.

A student who is excused under this policy must not be penalized for the absence, but the instructor may appropriately respond if the student fails to satisfactorily complete the assignment.

Absence due to officially approved trips: Department chairpersons, directors, coaches, or person responsible for a student representing the university on officially approved trips should notify the student’s instructors of the departure and return schedule in advance. The instructor so notified must not penalize the student, although the student is responsible for material missed.

Academic Integrity: It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and a high standard of integrity. The attempt of students to present as their own work that they have not honestly performed is regarded by the faculty and administration as a serious offense and renders the offenders liable to serious consequences, possibly suspension.

“Scholastic dishonesty” includes, but not limited to, cheating, plagiarism, collusion, falsifying academic records, misrepresenting facts, and any act designed to give unfair academic advantage to the student or the attempt to commit such an act.

Cheating: Dishonesty on examinations, quizzes, or homework assignments; illegal possession of examinations, the use of unauthorized notes during an examination or quiz, obtaining information during an examination from the examination paper or otherwise from another student, assisting others to cheat, alteration of grade records, illegal entry to or unauthorized presence in an office are instances of cheating.

Plagiarism: Offering the work of another as one’s own, without proper acknowledgement, is plagiarism; therefore any student who fails to give credit for quotations or an essentially identical expression of material taken from books, encyclopedias, magazines, and other reference works, or from the themes, reports, or other writings of a fellow student, is guilty of plagiarism.
Classroom Conduct: Students are expected to assist in maintaining a classroom environment that is conducive to learning. In order to ensure that all students have an opportunity to gain from time spent in the class, unless otherwise approved by the instructor; students are prohibited from using cellular phones or beepers or engaging in any other form of distraction. Inappropriate behavior in the classroom shall result in, minimally, a request to leave class.

1. Please turn off cellular phones and pagers, do not eat or drink in class, talk to neighbors, or engage in any other forms of distraction.

2. Please treat others with courtesy. People engaged in disruptive or rude behavior may be asked to leave the classroom.

3. Suspected cases of cheating or plagiarism will be handled according to the academic regulations of the University. If it is determined that cheating occurred, the student will be dismissed and fail the class.

4. Quizzes, problem sets, and exams may be made up only with a valid excuse, and prior approval of the instructor. Late problem sets will not be accepted because the answers will be discussed in the discussion section when due.

5. "The department, college, and university endorse PL 101-336, the Americans with Disabilities Act of 1990. Students with disabilities are encouraged to inform the faculty member so that any needed accommodations can be provided. All attempts will be made to maintain confidentiality."

6. It is the policy of the university to accommodate the religious observances of students, based on Texas statutes. If there are religious observances that would interfere with student participation in class events, please let the instructor know as soon as possible, so that alternate arrangements may be made.

Students with Disabilities: Any student who because of a disability may require special arrangements in order to meet course requirements should contact the instructor as soon as possible to make any necessary accommodations. Student should present appropriate verification from Access TECH. No requirement exists that accommodations be made prior to completion of this university procedure.

Office of the Ombudsman: The office of Ombudsman is available to assist student with any conflict or problem that has to do with being a student Texas Tech University. You can visit the Ombudsman in 202 Student Union Building or call 742-4791.

COURSE OUTLINE

- Cotton Fiber Morphogenesis
  - What is a cotton fiber?: An introduction to the cotton fiber in relation to similar cell types and standing in the plant kingdom.
  - Developmental programming of fiber morphogenesis and cell wall biogenesis:
    - Fiber expansion and primary cell wall biogenesis: mechanisms underlying determination of fiber length
    - Secondary cell wall biogenesis: unique attributes that provide fiber spinning characteristics
  - The cotton fiber transcriptome, proteome and metabolome:
- Overview of the genes required to make a fiber, and functional genomic approaches to identify candidate genes for genetic improvement of yield and fiber quality

- **Genetic Analysis of Fiber Traits**
  - **DNA Marker Technology:** An introduction to the basic enabling tools and genetic resources available to study complex plant genomes.
  - **Trait Mapping:**
    - **Quantitative Trait Loci (QTL):** Molecular analysis of biological processes and the underlying gene(s) that shape fiber development and quality characters.
    - **Positional Cloning:** The systematic positional approach to determine a gene structure and function.
  - **Candidate Gene Analysis:** Will focus on an integrated approach to study fiber biology by merging structural, functional, and phenotypic knowledge.

- **Cotton Fiber Properties and Measurement Technologies:**
  - **Introduction to macromolecular chemistry:** Basic overview of polymer chemistry sufficient to support the issues covered during the course; i.e., polymerization reactions, molecular weight, and degree of polymerization.
  - **Cotton fiber structure:** Chemical composition of cotton fibers, cellulose synthesis, structural properties of cotton fibers, physical properties of cotton fibers, cotton fiber morphology and molecular arrangement (hydrogen bonding, crystalline/amorphous region).
  - **Analytical techniques applied for cotton fiber development research**
    - **High Volume Instrument (HVI):** analysis of averages values of the main fiber properties such as length, micronaire and strength.
    - **Advanced Fiber Information System (AFIS):** analysis of single fibers for length and maturity and analysis of fiber length and maturity distributions.
    - **MANTIS:** analysis of single fiber measurements of strength and elongation.
    - **Cotton fiber cross-sections:** in depth analysis of individual fiber maturity and maturity distributions.
    - **Fourier Transform Infrared Micro-spectroscopy:** analysis of cotton cell wall composition and fiber development, obtain chemical information from very small sample and very small area (as small as 10 µm x 10µm), understanding the effect of genotypic differences on the structure of the fiber in the early stages of development.
    - **Gel Permeation Chromatography:** application for molecular weight distribution and degree of polymerization determination.
    - **Scanning Electron Microscopy:** application for analyzing the morphological variation between genotypes.
    - **Gas Chromatography / Mass Spectroscopy and High Performance Liquid Chromatography:** application for carbohydrates analysis of cotton cell walls, providing information on the sugar composition during fiber development.
    - **X-Ray diffraction:** Application to determine the crystallinity Index (% crystallinity), crystallites size, and their orientation and relationship with cotton fiber strength.
    - **Relationship between fiber properties and yarn quality**
## Tentative Calendar

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<tr>
<th>Week</th>
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<tr>
<td>1</td>
<td>Cotton fiber morphogenesis I</td>
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<td>2</td>
<td>Cotton Fiber Morphogenesis II</td>
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<tr>
<td>3</td>
<td>Cotton fiber transcriptome, proteome and metabolome I</td>
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<tr>
<td>4</td>
<td>Cotton fiber transcriptome, proteome and metabolome II</td>
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<td>5</td>
<td>DNA marker technology</td>
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<td>6</td>
<td>Trait mapping</td>
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<td>7</td>
<td>Candidate gene analysis</td>
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<td>8</td>
<td>Mid-Term Exam</td>
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<td>9</td>
<td>Macromolecular chemistry and cotton fiber structure</td>
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<td>10</td>
<td>Analytical techniques I</td>
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<td>11</td>
<td>Analytical techniques II</td>
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<td>12</td>
<td>Analytical techniques III</td>
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<td>13</td>
<td>Knowledge integration: Practical example I</td>
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<td>14</td>
<td>Knowledge integration: Practical example II</td>
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<td>15</td>
<td>Knowledge integration: Practical example III</td>
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<tr>
<td>16</td>
<td>Final Exam</td>
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